**An invasive freshwater mussel threatens aquatic ecosystems and water delivery infrastructure in California**

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The zebra mussel, *Dreissena polymorpha*, is a small, freshwater mussel usually less than 2 inches in length (Figure 1). Usually they have alternating light and dark brown stripes, but can also be solid light or dark brown (Figure 2). These mussels are only found in freshwater. Like the mussels found clinging to the rocks along the California coastline, zebra mussels attach onto hard surfaces (e.g. pipes, screens, rock, logs, boats, etc.). No other freshwater mussel or clam in California can attach onto a hard surface. Zebra mussels form colonies made up of many individuals attached to a single object.

Zebra mussels are native to the Caspian Sea and Aral Sea region near Russia and the Ukraine. They were first discovered in North America in Lake St. Clair, a small water body connecting Lake Huron and Lake Erie, in June 1988. Within months of the discovery, large numbers of zebra mussels began to appear in Lake St. Clair and along the northern shoreline of western Lake Erie. The distribution of zebra mussels now covers most of the midwestern United States and is expanding into eastern states (Figure 3).

Initial introductions were most likely from foreign ballast water releases. Dispersal has mostly been due to the mussel's ability to attach to boats and barges that are then either navigated or trailered to other waterbodies. Under cool and humid conditions, zebra mussels can survive out of water for several days. At California border crossings, inspectors have discovered several live and dead zebra mussels attached to boat hulls or in boat engine compartments (Figure 4).

Zebra mussels have caused millions of dollars in damage to water intake structures and delivery systems, such as those used for power and municipal water treatment plants in the eastern United States from the Great Lakes into the Mississippi drainage (Figure 5). Based on this information, water and power facilities in California have a high potential of being adversely affected by zebra mussels.

Ecological impacts associated with the invasion of zebra mussels would probably be similar to those seen after the introduction of the Asian clam, *Potamocorbula amurensis*, in 1986, albeit more in the freshwater components of the San Francisco Bay-Delta system and watershed. Like the Asian clam, zebra mussels are filter feeders and remove planktonic organisms, which are essentially the basis of the aquatic food web, from the water column. Studies have shown that zebra mussels have increased water clarity in Lake Erie up to six times what it was prior to their arrival. While increasing water clarity sounds like a good result, it is not. The increase in water clarity has resulted in an increase in the growth and expanse of aquatic plants many of which are also unwanted introduced pests.

The alteration of the aquatic food web and aquatic habitats in the Sacramento-San Joaquin Delta and upstream environment through the establishment of the zebra mussel

could negatively affect key fish species, such as Chinook salmon, delta smelt, splittail and striped bass.

In response to this threat, the California Department of Water Resources (DWR), with funding from the California Bay-Delta Authority (CALFED), implemented a comprehensive program to protect our watershed and water supply from the invasive zebra mussel.

## Zebra Mussel Watch Program

The “Zebra Mussel Detection and Outreach Program” is a multi-year project that began in 2001. The project entails a public outreach and education program, a risk assessment for California, an early detection monitoring program, and a rapid response plan. For outreach purposes, this project is referred to as the "Zebra Mussel Watch" program.

The objectives of the public outreach and education program are to provide information materials to all interested parties on how to identify zebra mussels, how to prevent their introduction (e.g., how to properly clean boats), and what to do if zebra mussels are found in California. This program focuses on several specific counties (Sacramento, San Joaquin, Butte, Fresno, Merced, Glen, Colusa and Tehama), but brochures and other information are circulated throughout California.

The risk assessment involves determining which waterbodies in California have a high risk of zebra mussel establishment. High risk areas have suitable zebra mussel habitat (e.g., substrate, pH, mineral availability), appropriate water temperatures for spawning, adequate food supplies, and high levels of boating activity.

Early detection monitoring is conducted at high risk areas in the Bay-Delta system, as well as rivers and reservoirs in Sacramento, San Joaquin, Butte, Fresno, Merced, Glen, Colusa and Tehama counties. Sampling primarily consists of suspending an artificial substrate for zebra mussels to attach onto and then checking this substrate for the presence of zebra mussels every month (Figure 6). The artificial substrate consists of a plexiglass plate and 2 PVC pipes filled with fabric mesh. These components are attached to a line of rope that is weighted at one end and can be suspended from a variety of structures located in the waterbody, including boat docks/slips, pipes, and piers. The artificial substrate monitoring is conducted by private citizens, marina staff, DWR staff, and staff from other agencies. During peak spawning months, DWR staff will sample for planktonic zebra mussel larvae. This more active form of sampling will only occur in areas deemed to be exceptionally high risk sites.

A centralized system is being established for reporting zebra mussel sightings. This system consists of a toll-free “zebra mussel hotline” and a website. Key information about zebra mussel sightings will be distributed via email, the Internet and phone calls to all necessary agencies, organizations, and facilities. A list of appropriate personnel from these agencies, organizations and facilities is currently being compiled and will continually be updated as new parties express interest in being notified.

A rapid response plan is being developed to provide guidelines for zebra mussel sighting confirmation and appropriate eradication measures. This plan will provide a list of regulatory agencies to contact in the event of zebra mussel detection, identify the

regulatory approvals necessary, identify the funds necessary for eradication of zebra mussels in California, and propose control and eradication strategies.